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CONCEPT IDENTIFICATION AS A FUNCTION OF INSTRUCTIONS, LABELS, SEQUENCE, CONCEPT TYPE, AND TEST ITEM TYPE.

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THE EFFECTS OF INSTRUCTIONS, TYPE OF LABEL, TYPE OF CONCEPT, AND SEQUENCE OF CONCEPTS BY TYPE UPON CONCEPT IDENTIFICATION WERE INVESTIGATED IN THIS STUDY. PERFORMANCE WAS ANALYZED IN TERMS OF FOUR TYPES OF TEST ITEMS. INSTRUCTION, FOCUSING ON THE CONCEPT TO BE ATTAINED AND THE CONCEPT NATURE, WAS FOUND TO FACILITATE CONCEPT IDENTIFICATION SIGNIFICANTLY BETTER THAN INSTRUCTION DESIGNED ONLY TO ACQUAINT STUDENTS WITH STIMULUS MATERIALS. STUDENTS PERFORMED AS WELL ON A SEQUENCE IN WHICH THEY IDENTIFIED TWO CONJUNCTIVE CONCEPTS FOLLOWED BY DISJUNCTIVE CONCEPTS AS THEY DID ON A SEQUENCE OF TWO DISJUNCTION CONCEPTS FOLLOWED BY TWO CONJUNCTIVE CONCEPTS. PRIOR EXPERIENCE WITH EITHER CONJUNCTIVE OR DISJUNCTIVE CONCEPTS TENDED TO LOWER LATER PERFORMANCE ON THE OTHER TYPE OF CONCEPT. USE OF LABELS OF HIGH FREQUENCY OCCURRENCE DID NOT RESULT IN PERFORMANCE SIGNIFICANTLY DIFFERENT FROM THAT OF LABELS OF LOW FREQUENCY OCCURRENCE. EXAMPLES OF THE CONCEPT CONTAINING NEITHER OR BOTH RELEVANT ATTRIBUTES WERE EASIER FOR SUBJECTS TO CLASSIFY AS BELONGING OR NOT BELONGING TO THE CONCEPT THAN EXAMPLES WITH ONLY ONE OR THE OTHER RELEVANT ATTRIBUTE PRESENT. (JC)

Technical Report No. 6

CONCEPT IDENTIFICATION AS A FUNCTION OF INSTRUCTIONS, LABELS, SEQUENCE, CONCEPT TYPE, AND TEST ITEM TYPE

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Based on a master's thesis
under the direction of

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PREFACE

The goal of the Center is to improve cognitive learning in children, youth, and adults. One step in achieving this goal is to conduct research which contributes to the science of human behavior on the one hand and to educational technology on the other. One part of the total research program deals with concept learning; the related research focuses on five major classes of variables--stimulus, instructions, motivation, response modes, and organismic. This study clarifies relationships among variables from three classes—stimulus, instructions, and response. As indicated in this study, two of the most important variables to pursue further in advancing the technology of instruction are type of concept to be learned and instructions about specific tasks to be performed.

Herbert J. Klausmeier
Co-Director for Research
Professor of Educational Psychology

March 22, 1966

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ABSTRACT

The effects of instructions, type of label, type of concept, and sequence of concepts by type upon concept identification were investigated in this study. Performance was analyzed in terms of four types of test items.

Instructions designed to help students recognize that there was a concept to be attained, and also the nature of the concept, facilitated concept identification significantly better than did instructions designed only to acquaint students with the stimulus material. Students performed as well on a sequence in which they identified two conjunctive concepts followed by two disjunctive concepts as they did on a sequence of two disjunctive concepts followed by two conjunctive concepts. A significant interaction of sequence and concept type indicated an Einstellung effect such that prior experience with either conjunctive or disjunctive concepts tended to lower later performance on the other type of concept. The use of labels of high frequency of occurrence did not result in performance significantly different from that of the use of labels of low frequency of occurrence.

Exemplars of the concept containing neither or both relevant attributes were significantly easier for Ss to classify as belonging or not belonging to the concept than exemplars with only one or the other relevant attribute present. This effect is probably related to the relative amount of redundant relevant information contained in the four types of exemplars.

I
INTRODUCTION

Research in concept identification has been mushrooming in recent years. Much has been done since the early work of Hull (1920). The relatively recent work of Bruner, Goodnow, and Austin (1956) is already a classic.

The independent variables investigated in this study were instructions, labels, sequence, concept type, and test item type. Concept identification experiments having instructions as an independent variable have produced widely differing results. Since instructions enter into every teaching-learning situation and since instructions are always a part of experiments involving human subjects, research clarifying instructional effects was needed. Labels also have produced varying effects in concept identification. Their effects on concept identification needed additional research because labels are basically all that is used to communicate concepts. Sequence and concept type effects were studied in this experiment to extend the generality of the findings concerning the first two independent variables. Test item type was investigated because it was felt that this might affect the measurement of the subjects' performance.

"Test item type" refers to the test instances used in concept identification tasks in which performance is measured by how well the subject can classify these test instances. In a concept identification task in which two bi-level dimensions are relevant, a test instance can have one of four sets of attributes. It can contain both relevant attributes (e.g., if the concept were "red circles," all cards containing red circles would be in this category); it can contain one relevant attribute (e.g., red squares if the concept is "red circles"); it can contain the other relevant attribute (e.g., green circles); and it can contain neither relevant attribute (e.g., green squares). Experiments studying redundancy and relevancy of stimulus information shed light on what performance to expect from subjects on each of these four item types, but no one had empirically verified what the subjects' performance was on each of these item types. This variable needed to be investigated because some of the results that have already been attained in concept identification may be a result of the test items used to determine whether the subject has identified the concept.

The purposes of this study were:

1. To determine the effect on concept identification of instructions designed to help a subject recognize the nature of the concept to be identified.

2. To determine the effects of high occurrence frequency and low occurrence frequency labels on concept identification.

3. To determine differences between conjunctive and disjunctive concept identification pertaining to the other variables of this experiment.

4. To determine the effects on concept identification of two different task sequences using the same conjunctive and disjunctive concepts.

5. To analyze performance in terms of four types of test items.

II

REVIEW OF RELATED LITERATURE

A review of the literature since 1950 pertaining to the effects of instructions, labels, sequence, concept type, and item type on concept identification as they are related to the stated purposes of this experiment is presented in this chapter. The main source of references used in this review was the technical report (Klausmeier, Davis, Ramsay, Fredrick, & Davies, 1965) that covers the period 1950-1964.

INSTRUCTIONS EFFECTS

Archer, Bourne, and Brown (1965) did not find that instructions improved overall performance but they did find indications that instructions were more useful to Ss as the concept identification tasks became more complex.

Underwood and Richardson (1956) found that a S's acquisition of concepts became more rapid as he was given more information concerning the nature of the concepts to be learned.

Carpenter (1956) found that young children who learned the organization of the Vigotsky blocks through trial and error retained it much better than children who were told what the organizational characteristics were. On the other hand, trial-and-error Ss took a significantly longer time to learn this organization.

Osler and Weiss (1962) using school children found that instructions had effects that depended on the age level of the Ss.

Wittrock (1963) found his instructions to have the following effects:

> When the criterion is initial learning of a few responses, explicit and detailed direction seems to be most effective and efficient. When the criteria are retention and transfer, some intermediate amount of direction seems to produce the best results (p. 189).

Tagatz (1963) found that instructions clarifying the nature of the relationships of the stimulus cards lowered performance in his experiments.

Laughlin (1964) found that instructions could be used to influence time to criterion but not number of card choices to criterion.

Klausmeier, Harris, and Wiersma (1964) found: "Instructions which presented information about a strategy were most efficient; those explaining the structure of the material were second; and minimal instructions were least efficient" (p. 110).

Fredrick (1965) and Kalish (1965) both found that Ss receiving information concerning the nature of the concepts to be identified performed significantly better than Ss not receiving this information.

It would seem from the above that instructions can have positive, negative, or neutral effects depending on the instructions themselves and on the remainder of the experimental situation. It should be pointed out that all of the above studies concern the effects of instructions on conjunctive concept identification. No matter what conclusions one draws from the results cited above, these conclusions are not necessarily applicable to disjunctive concept identification.

LABELING EFFECTS

The literature concerning the effects of instance labeling on concept identification is limited and somewhat contradictory.

Carey and Goss (1957) investigated the effects of labels as mediating verbal responses affecting children's sorting behavior. Labels directly related to the nature of the stimulus materials facilitated the classifying of the materials significantly more than nonsense labels did.

Robinson (1955) found no significant differences due to labels when labels were used in learning a set of pictorial stimuli for later perceptual discrimination.

Dietze (1955) found that children learned to name forms more easily when distinctive names were used than when similar names were used. Later (1965) she replicated this finding for two out of three different discrimination training sequences. For the third sequence there was no difference.

Katz (1963) found that Ss discriminated differences in stimuli with distinct labels significantly better than they discriminated differences in stimuli having common labels.

Kluppel and Jeffrey (1964) did not find a significant effect due to labelability of the stimulus.

It would seem from these studies that labels directly related to the nature of the stimulus materials will have a positive effect on concept identification. The labels themselves will be easier to learn if they are distinctive. The above studies do not indicate whether or not the frequency with which a S has encountered a given label will influence his performance on concept identification.

SEQUENCE EFFECTS

The only study (Conant & Trabasso, 1964) that was found directly related to sequence effects in concept identification tasks did not show any significant sequence effects. Using two sequences, one of three disjunctive concepts followed by three conjunctive concepts and one of three conjunctive concepts followed by three disjunctive concepts, Conant and Trabasso found no transfer effects from one problem type to another.

Petre (1964) found that training on stimulus material classifications dissimilar to the classifications used in his concept identification tasks produced negative transfer effects. If one examines his protocols closely, one sees that condition DF (direct facilitation—the condition producing the best performance) was nothing more than pretraining on conjunctive organization of the stimuli while condition DI (direct interference—the condition producing the worst performance) was pretraining on disjunctive organization of the stimuli. Subjects' test tasks were always conjunctive in nature. Looking at the Einstellung or problem-solving set effect (Luchins, 1942), one would expect the results obtained by Petre. This raises the question of why this effect did not appear in Conant and Trabasso's study. It should have shown up as an interaction of concept type with sequence.

EFFECTS OF CONCEPT TYPE

Many studies have shown that conjunctive concepts are easier to attain than disjunctive concepts (Bruner et al., 1956; Hunt, 1962; Petre, 1964). However, the relationships of this variable to the other variables of this experiment have not been shown. To show these relationships and to partial out the variance in this experiment due to concept type, concept type was made a main variable.

EFFECTS OF TEST ITEM TYPE

While there is no literature in which the experimenter directly investigates the relative effect of different test items used in determining whether or not the S has identified the concept, there is literature concerning relevant and irrelevant stimulus redundancy that sheds some light on what to expect from this variable.

Bourne and Haygood (1959; 1961) found that redundant relevant information facilitated concept identification while redundant irrelevant information tended to hinder concept identification. In a later study Haygood and Bourne (1964) replicated this result.

Archer (1963) found that the greater the amount of irrelevant information the poorer the performance on concept identification was.

Looking at the variable of test item type, one sees that the test items that contain neither or both relevant attributes possess a bit of redundant relevant information that is not possessed by the test items containing only one or the other relevant attribute. Therefore the test items containing both or neither relevant attributes should be easier to classify as exemplars or non-exemplars of the concept than test items containing only one or the other relevant attribute.

III
METHOD

EXPERIMENTAL DESIGN

Measures of performance were obtained from each S on four concept identification tasks. There were eight treatment groups formed as a result of the three bi-level variables of instructions (optimal and minimal), labels (high frequency and low frequency), and sequence. Within each treatment group, all Ss did both types of concepts and responded to all four types of test instances for each concept. There were eight examples of each item type presented in random order in the 32 test instances following each concept. The factor of concept type was a repeated measure in that each S performed on each concept type. Within concept type was nested the four-level factor of test item type. As a result of this design, there were eight measures of the dependent variable obtained from each S.

SUBJECTS

The Ss were 82 junior, senior, and graduate students in an educational psychology course at the University of Wisconsin. With the restriction that they be female, two Ss were randomly discarded from two groups (one from each group) to make these groups the same size as the other groups of the experiment. Data from 14 males and 66 females were used to determine the results of the experiment. As far as possible the proportion of males to females was kept the same for all groups.

EXPERIMENTAL MATERIALS

The materials and instructions used in this experiment were developed by Fredrick (1965) and modified by the experimenter.

The stimulus materials were two series of colored slides containing geometric figures which varied in value for each of five attributes. The attributes and their corresponding values were:

number of figures . . . one or two
size of figures . . . . . large or small
color of figures . . . . red or green
texture of figures . . . plain or spotted
shape of figures . . . . circle or square

For the conjunctive concepts, six slides were used to uniquely define each of the 2 two-attribute concepts ("two textured" and "small green"). For each of the 2 two-attribute disjunctive concepts ("red or square" and "one or circle"), seven slides were used. For all concepts the first slide was a positive instance (i.e., focus card). For the conjunctive concepts, each remaining slide varied on only one dimension from the first slide. The first conjunctive concept was that used by Fredrick. This was used in hope of replicating the results he found concerning the effects of labels and instructions. The instances for presenting the second conjunctive concept were randomly chosen within the restrictions stated in the third and fourth sentences of this paragraph. Because experience had shown that disjunctive concepts were very hard tasks for Ss and because the experimenter wanted Ss to be performing above chance level, a presentation order was chosen for each disjunctive concept that, it was hoped, would facilitate learning the concept.

The presentation slides for each concept were followed by 16 slides containing 32 test items. The 32 test items were the cards that resulted from all the combinations of the five bi-level dimensions. This means that, for each concept, the presentation instances were also used as test instances randomly distributed throughout the other test items.

Each S received a booklet containing instructions and response sheets. A tape recorder and slide projector were connected so that once the booklets were properly distributed the whole experiment proceeded automatically following the press of a button.

EXPERIMENTAL PROCEDURE

For most Ss participation in some educational psychology experiment was a class requirement. Subjects were randomly assigned to experimental groups within the restriction of keeping the ratio of males to females approximately constant for all groups.

Upon arriving at the experiment room, Ss sat down facing a projection screen. After receiving their booklets, they filled in the front page with their name, age, sex, year in school, and major. After this a button was pressed on a tape recorder to start the experiment. The tape contained instructions pertaining to the mechanical procedures of the experiment; e.g., "Please read the three pages of information and directions and follow any directions given." The tape also contained recorder signals used to trigger the slide projector into changing slides.

The instructions variable was manipulated by means of instructions written in the booklets received by the Ss. It will be noted in the optimal instructions that follow that in order for them to fulfill their purpose of helping a S to recognize the nature of the concept to be identified, the optimal instructions had to serve the following four functions mentioned in Gagné's list:

1. Presenting the stimulus . . . .
2. Directing attention and other learner activities . . . .
3. Providing a model for terminal performance . . . .
4. Guiding the direction of thinking . . . . (1965, pp. 268-269).

The minimal instructions fulfill the first and second functions.

Subjects having optimal instructions with conjunctive concepts occurring first received the following instructions before being presented with their first concept:

> In this experiment you are going to identify concepts that I have in mind. A concept in this experiment is used to classify sets of cards into two groups, one set belongs to the concept and the other set does not. Let's clarify further how we are using the term "concept" in this experiment. There is a card with one large textured green square. Suppose that I told you "yes," meaning the card belongs to the concept I have in mind. This would tell you that the concept I have in mind might be any possible combination of the features of the card.

> Your first two tasks will involve identifying "conjunctive" combinations of features. In such a concept the features that are combined to form the concept must all be present for a card to be a member of the concept.

> Suppose that while showing this slide I told you "yes," meaning this card belongs to the concept I have in mind. This would tell you that the concept I have in mind might be large square, or one large, or one textured, or green textured, or any other combination of features of the card. You would need more cards, however, to tell exactly what the concept is. Suppose I presented a second card that was identical to the first one except that it had one small textured green square, instead of one large textured green square. If I told you, "no," meaning this card does not belong to the concept, you could infer that all cards having small figures do not belong to the concept. The 3rd card I present might be identical to the first one except that it contained a circle instead of a square. I might tell you "yes" meaning it does belong to the concept. You would know that shape (circles and squares) is not relevant to the concept. Still other cards would be needed to tell exactly what the concept is. Thus, this type of concept is formed by joining features of a card such as joining "large" with "green." All cards in which the figures were both large and green would be examples of the concept. All other cards would not be examples. In this experiment the label below each card will tell you which cards are in the concept.

> You are going to see slides which have geometric figures on them. Some of these figures will be circles and some will be squares. The figures can be large or small red or green, solid or textured. There can be either one circle or two circles, or one square or two squares on a slide. The slide you are looking at is an example. It is described as one, large, textured, green square figure. When it appears that everyone is finished reading these instructions, another slide will be shown for you to describe.

> Write description here:

The last paragraph above and the instruction following it were read by all Ss under all conditions of the experiment. Following these instructions $\underline{S}$s were shown the presentation instances of the first conjunctive concept. Following the presentation items were the 32 test items for the first concept. The second conjunctive concept was presented in the same manner as the first with no special instructions separating the two. Before the presentation of the first disjunctive concept $\underline{S}$s read the following instructions:

> Your next two tasks will be different from your first two tasks. They will involve "disjunctive" concepts. In such a concept, only one of the features from the combination of features must be present for the card to be a member of the concept. For example, if the concept were "large or green," it would mean that all cards containing large figures, all cards containing green figures, and of course all cards containing figures that were both large and green would be examples of the concept.

The disjunctive concepts were then presented in the same manner as the conjunctive concepts had been.

Optimally instructed $\underline{S}$s receiving disjunctive concepts first read the following before reading the paragraph that all $\underline{S}$s read:

> In this experiment you are going to identify concepts that I have in mind. A concept in this experiment is used to classify sets of cards into two groups, one set belongs to the concept and the other set does not. Let's clarify further how we are using the term "concept" in this experiment. There is a card with one large textured green square. Suppose that I told you "yes," meaning the card belongs to the concept I have in mind. This would tell you that the concept I have in mind might be any possible combination of the features of the card.
>
> Your first two tasks will involve identifying "disjunctive" combinations of features. In such a concept, only one of the features from the combination of features must be present for the card to be a member of the concept. For example, if the concept were "large or green," it would mean that all cards containing large figures, all cards containing green figures, and of course all cards containing figures that were both large and green would be examples of the concept.

This was followed by the presentation of the two disjunctive concepts. Subjects then received the following set of instructions to prepare them for conjunctive concepts:

> Your next two tasks will be different from your first two tasks. They will involve "conjunctive" concepts. In such a concept, the features that are combined to form the concept must all be present for a card to be a member of the concept.
>
> As you can recall, the first example card that was presented at the beginning of this experiment contained one large textured green square. Suppose that while showing this slide I told you "yes," meaning this card belongs to the concept I have in mind. This would tell you that the concept I have in mind might be large square, or one large, or one textured, or green textured, or any other combination of features of the card. You would need more cards, however, to tell exactly what the concept is. Suppose I presented a second card that was identical to the first one except that it had one small textured green square, instead of one large textured green square. If I told you "no," meaning this card does not belong to the concept, you could infer that all cards having small figures do not belong to the concept. The third card I present might be identical to the first one except that it contained a circle instead of a square. I might tell you "yes" meaning it does belong to the concept. You would know that shape (circles and squares) is not relevant to the concept. Still other cards would be needed to tell exactly what the concept is. Thus, this type of concept is formed by joining features of a card such as joining "large" with "green." All cards in which the figures were both large and green would be examples of the concept. All other cards would not be examples. In this experiment the label below each card will tell you which cards are in the concept.

As can be seen the optimal instructions were as identical as reasonably possible under the two orders in which the concepts were presented.

Subjects in the minimally instructed groups under all conditions read material not concerned with the experiment during the time that the optimally instructed $\underline{S}$s were reading their special instructions. The material used before the first two concepts was:

Before we begin the experiment let us tell you something about the University of Wisconsin's Research and Development Center for Learning and Re-education. The main goal of the R & D Center is to improve the efficiency of learning, primarily in school settings. It is hoped that through research, a unified theory of teaching and learning may be formulated that is empirically verifiable in terms of learning outcomes desired in the students. The criteria of improving efficiency include these three outcome variables: more initial learning in less time, better retention of learned material, and better use of learned material. As the name would imply, work at the Center may be classified in two categories: research activities and development activities.

The research activities are of two main types. The first type deals with clarification of teaching-learning processes, guided by a theory of instruction. In the present work in elementary mathematics, for example, supplementary instructional material is being incorporated into video tapes at the various grade levels of the elementary school. Small-scale controlled experiments are undertaken to determine what may be appropriate content for children of varying characteristics at the different grade levels. Also, various elements of instructional methodology are manipulated to determine which achieves more efficient student learning. The attempt may also be made to determine the effects the video tape material has upon the teachers' use of mathematics instructional materials and methods. A second example involves structural grammar in the junior and senior high school. Structural grammar is organized on an a priori basis, using the best judgments of experts. Once this material is organized, different instructional treatments are applied. One set of variables is manipulated at a time. Student characteristics within a grade level and grade or school level are stratifying variables. It is hoped that by proper research a truly optimum method of teaching structural grammar will be produced.

Besides the experimentation with human subjects, research is also being done with the computer to identify processes. It will be interesting to learn whether the two different approaches yield similar results.

After this material, minimally instructed Ss read the same last paragraph as the optimally instructed Ss did. After the first two concepts had been presented, Ss in the minimally instructed groups received the following material to read:

> You have now completed the first two tasks of four that comprise this experiment. While you are relaxing before the next two tasks let us tell a little more about the Center. The Center is an offshoot of the School of Education at the University. The School of Education is comprised of all professors who offer any courses in any department that is required in any program of teacher-education. All of the academic disciplines and such special areas as agriculture, home economics, and music are included in the School of Education. The Center is comprised of professors and students from the various disciplines who have already been working together on various projects in the School of Education.
>
> The Center maintains close working relationships with the State Department of Public Instruction. Through the State Department it has facilities for dissemination of educational research findings and of new instructional models. Through the State Department, the Center has access to most of the public schools in the state.
>
> Now that you have had a short period of rest, you will do the remaining two tasks. These will be different problems. Please watch these series of slides closely. You will be asked questions about them.

The labels variable was manipulated by having either the high or low frequency labels on the presentation slides beneath the instances. The labels for each concept were as follows: MAN and ZGI for the concept "two textured"; PLACE and XFQ for the concept "small green"; YEAR and QIH for the concept "red or square"; HAND and XZF for the concept "one or circle." A positive instance of the concept would have the noun or consonant label while a negative instance of the concept would have the label and the word NOT before it. The high frequency labels were taken from Thorndike's Teacher's Word Book of 30,000 Words (1944). They were chosen on the basis of being one-syllable nouns of very high occurrence frequency as shown by the list in Part IV of the book. The low frequency consonant triads were taken from a list compiled by Underwood and Schulz (1960, p. 319).

The instruction written above the answer blanks for each concept was:

> Write "yes" if the card would be labeled ______and write "no" if the card would be labeled NOT___. Please answer for each card regardless of whether or not you are certain about the answers.

The label used for the particular concept that the S was working on was in the places that have been left blank above.

Only two levels of the sequence variable were used in this experiment. The conjunctive concept "two textured" always preceded the conjunctive concept "small green." The disjunctive concept "red or square" always preceded the disjunctive concept "one or circle." The two sequences used were $C_1 C_2 D_1 D_2$ and $D_1 D_2 C_1 C_2$ (C stands for conjunctive and D for disjunctive). The former sequence was Sequence I and the latter sequence was Sequence II.

All Ss received both levels of the variable of concept type (conjunctive and disjunctive).

The test items following the presentation of each concept were of four types. There were eight examples of each type of test item in each set of test items. The four types of test items were: (1) those test items containing both relevant attributes of the concept (Item Type I), (2) those items containing only one relevant attribute of the concept (Item Type II), (3) those containing only the other relevant attribute of the concept (Item Type III), and (4) those containing neither relevant attribute (Item Type IV). In this manner all Ss received all four levels of the variable of test item type.

DEPENDENT VARIABLE

The dependent variable in this experiment was the number of test items correctly responded to by S on each level of the independent variables.

IV
RESULTS

The raw scores, the mean scores for each significant main effect, and the mean scores for each significant interaction are contained in the tables and appendix of the thesis on which this report is based (Lynch, 1966).

Subjects' correct responses were analyzed by means of an analysis of variance which is presented in Table 1. It revealed significant main effects due to instructions ($p < .01$), concept type ($p < .001$), and test item type ($p < .001$). It did not reveal any main effects due to sequence or labels. It revealed a first order interaction of sequence and concept type ($p < .05$). The following second order interactions were also revealed: (a) sequence by labels by concept type ($p < .01$), (b) instructions by sequence by item type ($p < .01$), and (c) instructions by concept type by item type ($p < .05$).

The effect of instructions was that Ss with optimal instructions did better than Ss with minimal instructions.

The effect of concept type was, as expected, that Ss did better on conjunctive than on disjunctive concepts.

The effect of test item type was that Item Types I and IV were easier for Ss than Item Types II and III. A Sheffe post-hoc means comparison revealed the difference between these two pairs of means to be significant ($p < .01$).

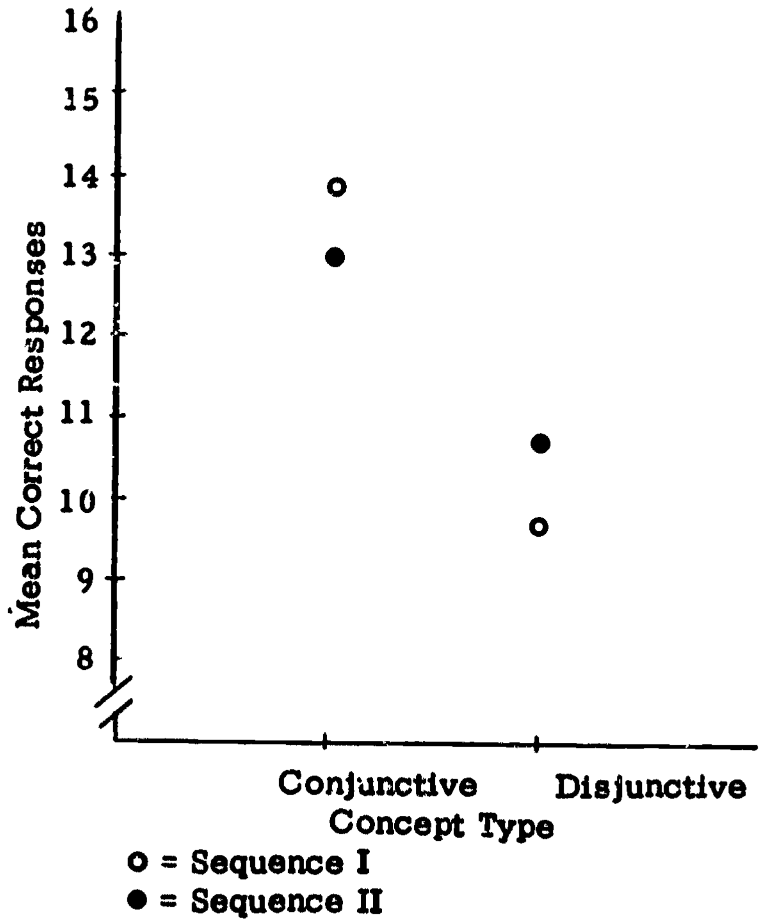

Fig. 1. Interaction of concept type and sequence.

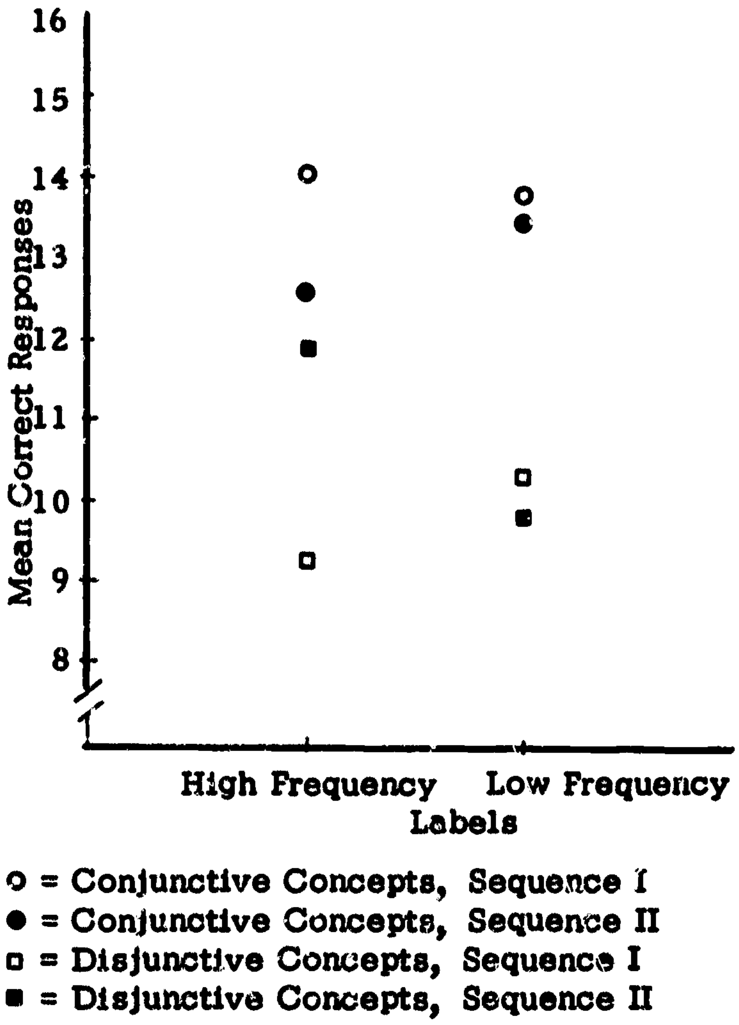

Fig. 2. Interaction of sequence, labels, and concept type.

The sequence by concept type interaction effect is presented in Figure 1. Since Ss performed conjunctive concepts first in Sequence I and disjunctive first in Sequence II, the results indicate that performance on either type of concept was better when that type preceded the other type than when it followed the other type.

The sequence by labels by concept type interaction is presented in Figure 2. The tendency illustrated by this interaction is that performance was better on a concept type with a high frequency label than on this same concept type with a low frequency label when it occurred as the first concept type done by the Ss. When it occurred second, performance was better under the low label condition.

The interaction of instructions, sequence, and test item type is presented in Figure 3. It will be noticed that performance on Item Type IV in Sequence I with optimal instructions and in Sequence II with minimal instructions accounts for much of the variance that occurs in this interaction due to test item type. Except

Table 1

Analysis of Variance of Correct Responses

Source	SS	df	MS	F
I (Instructions)	292.95	1	292.95	11.49 **
S (Sequence)	.97	1	.97	< 1
L (Labels)	2.38	1	2.38	< 1
I × S	47.85	1	47.85	1.88
I × L	12.38	1	12.38	< 1
S × L	39.50	1	39.50	1.54
I × S × L	39.50	1	39.50	1.54
Ss / I S L	1836.24	72	25.50	
C (Concept Type)	1603.39	1	1603.39	62.75 ***
I × C	58.20	1	58.20	2.27
S × C	159.00	1	159.00	6.22 *
L × C	29.33	1	29.33	1.15
I × S × C	51.19	1	51.19	2.00
I × L × C	20.66	1	20.66	< 1
S × L × C	181.69	1	181.69	7.11 **
I × S × L × C	16.58	1	16.58	< 1
C × Ss / I S L	1839.38	72	25.55	
T (Test Item Type)	283.11	3	94.37	11.04 ***
I × T	44.71	3	14.90	1.74
S × T	28.86	3	9.62	1.13
L × T	52.56	3	17.52	2.05
I × S × T	154.48	3	51.49	6.02 **
I × L × T	63.96	3	21.32	2.49
S × L × T	13.76	3	4.58	< 1
I × S × L × T	13.41	3	4.46	< 1
T × Ss / I S L	1845.81	216	8.55	
C × T	9.29	3	3.10	< 1
I × C × T	91.53	3	30.50	3.85 *
S × C × T	1.11	3	.37	< 1
L × C × T	25.18	3	8.39	1.06
I × S × C × T	47.32	3	15.77	1.99
I × L × C × T	8.34	3	2.78	< 1
S × L × C × T	12.64	3	4.21	< 1
I × S × L × C × T	8.01	3	2.66	< 1
Residual	1711.71	216	7.92	

* $P < .05$
** $P < .01$
*** $P < .001$

for Item Type IV, performance was generally better under the optimal instructions, Sequence I condition than under the optimal instructions, Sequence II condition. Except for Item Type IV, performance was generally better under the minimal instructions, Sequence II condition than under the minimal instructions, Sequence I condition. That much of the variance due to test item type occurring in this interaction is located in Item Types III and IV is illustrated by the fact that a Scheffe post-hoc comparison of the means of Item Type IV under the optimal instructions, Sequence II condition and minimal instructions, Sequence I condition with the means of Item Type III under these same conditions reveals these two sets of means to be significantly different ($p < .05$).

The interaction of instructions, concept type, and test item type is presented in Figure 4. It can be seen that the spread between optimal and minimal instructions on conjunctive concepts gets progressively greater as one goes from Test Item Type I to Test Item Type IV indicating a simple interaction of instructions with test item type on conjunctive concepts. Disjunctive concepts exhibit a different relationship such that the spread between performance under the optimal instructions condition and performance under the minimal instructions condition is greatest on Item Type II where performance is better under the optimal instructions condition. On these same disjunctive concepts Item Type IV performance is better under the minimal instructions condition.

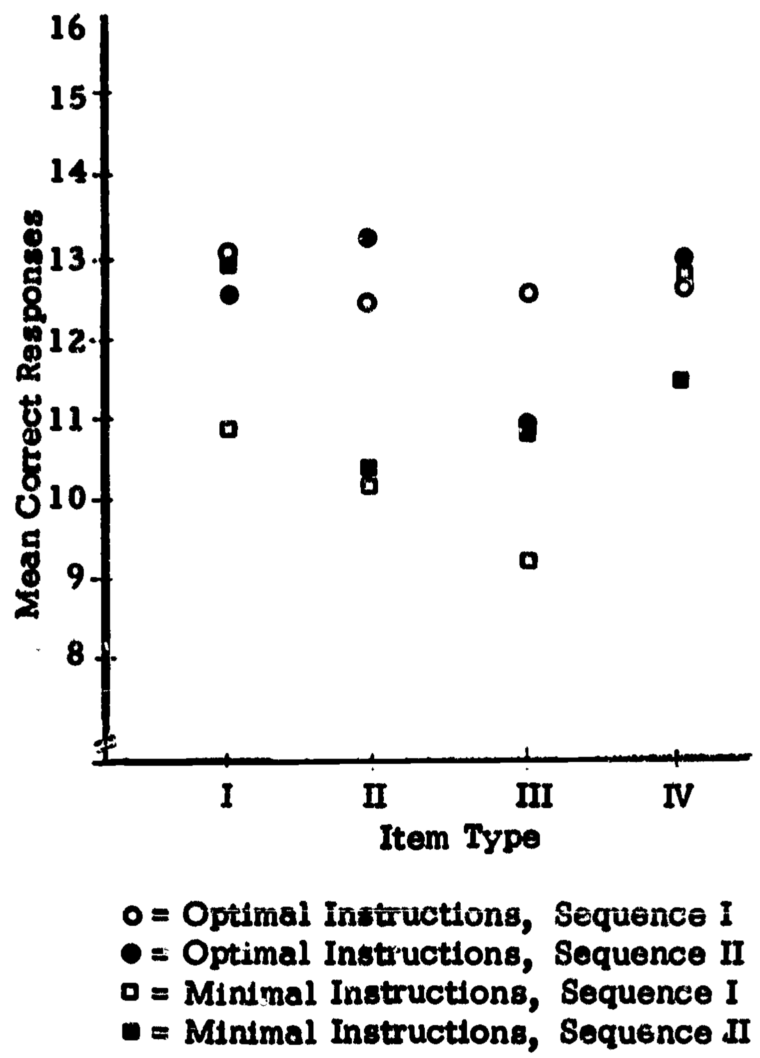

Fig. 3. Interaction of instructions, sequence, and test item type.

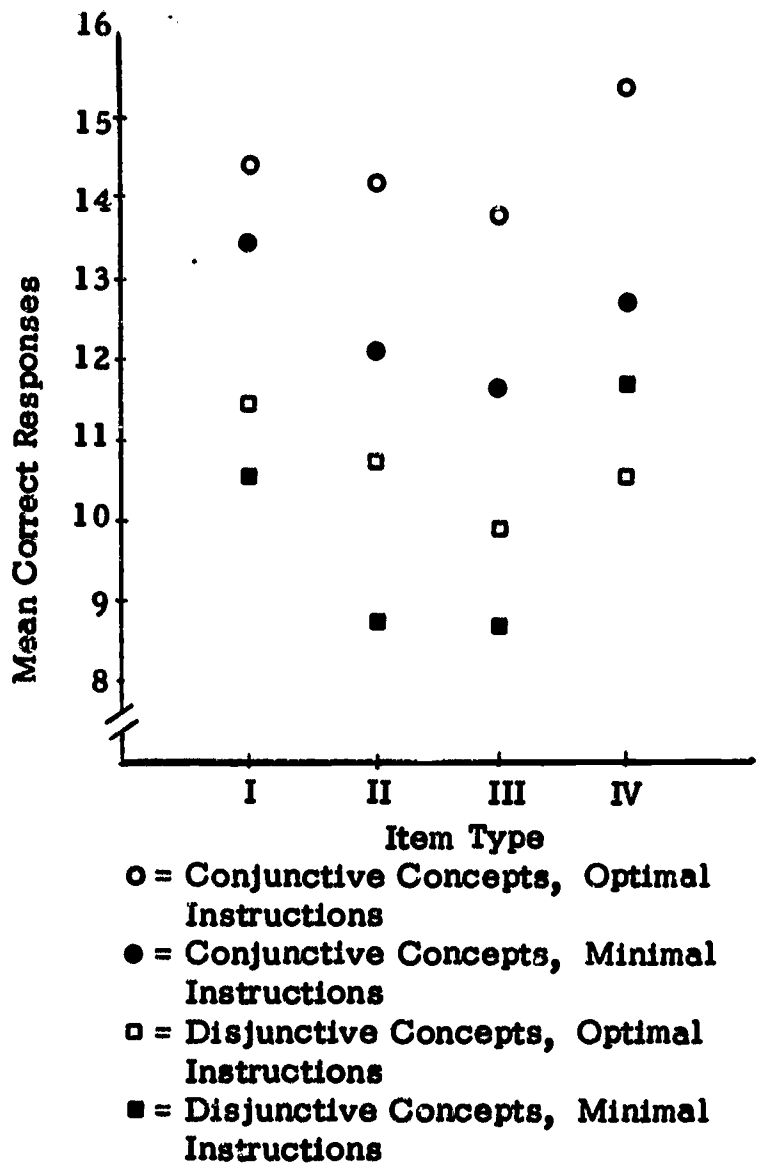

Fig. 4. Interaction of instructions, concept type, and test item type.

V

DISCUSSION

The instructions effect was significant. Therefore, on the tasks used in this experiment, instructions designed to help the S recognize the nature of the concept to be identified aided the S more than did instructions designed only to acquaint the S with the stimulus material. This result seems to be in direct contradiction to that obtained by Tagatz (1963). However, if one examines Tagatz's instructions one finds that they were primarily intended to give S a knowledge of the organization of the stimulus material and not to provide the S information about how he was to go about accomplishing his concept identification task. Tagatz's instructions probably placed a memory load on Ss which in turn lowered their performance. Tagatz's instructions consisted of seven complex rules concerning the relationships of things the S had never seen before the experiment; namely, positive and negative cards, focus cards, focus rows, and intersection cards. All of Tagatz's rules and terminology in his special instructions were unnecessary for teaching a S how to attain a concept. Furthermore, the stimulus materials used with the instructions were different from those used on his concept identification tasks. Probably as a result of these conditions his instructions significantly lowered performance while those in the current experiment significantly improved performance.

The greater difficulty of attaining disjunctive concepts is well known (Bruner et al., 1956), and so the significant effect showing conjunctive concepts to be more easily identified than disjunctive ones is not surprising. What is interesting is that this result holds true for Ss under both the optimal and minimal instruction conditions. One of the properties of the stimulus materials used is that all negative instances of a conjunctive concept are members of the same inclusive disjunctive concept while all negative instances of an inclusive disjunctive concept are members of the same conjunctive concept. (For a more adequate description of this phenomenon, see Hunt, 1962, pp. 176-181). If uninstructed Ss had attempted to focus on the conjunctive attributes of the negative instances of the disjunctive concepts, they should have been able to perform as well on them as they did on the conjunctive concepts. It would seem that the word "NOT" used in each label of a negative instance served as a cue to the S to not be as concerned with these instances as the other instances. It is possible that if the word "NOT" were removed from the labels of negative instances and different labels placed on the negative instances the difference between conjunctive and disjunctive concept identification by uninstructed Ss would disappear in an experiment like this one.

Since the F ratio for the labels effect is considerably less than 1, it would seem that the frequency with which labels occur in a S's previous experience will have little effect on how the S will perform in a novel concept identification task. Although their previous occurrence frequency seems to have little effect, it definitely cannot be concluded that labels do not affect concept identification. As pointed out before, the use of the cue word "NOT" in the labeling of negative instances probably has an effect on Ss' performance. If labels directly related to the nature of the task had been used (e.g., using "two textured" as the label for positive presentation instances of the first conjunctive concept) as they were used in the Carey and Goss (1957) experiment, it is probable that Ss would have performed better with this type of label.

Although labels do not have a significant main effect, they obviously have some influence on other variables as can be seen from the significant second order interaction involving sequence, labels, and concept type. Why high frequency labels should seem to facilitate learning a concept more than low frequency labels when the concept occurs without previous training and why low frequency labels should seem to facilitate learning concepts more than high frequency labels when the concept occurs after prior training on a different concept type is unclear. Perhaps, the high frequency labels serve as a distractor after the S has experience with the task.

The effect of test item type was that Item Types I and IV were significantly easier to identify as exemplars or non-exemplars of the concept that Item Types II and III. Items of Type I were those containing both relevant attributes and items of Type IV were those containing neither relevant attribute. Items of Types II and III were those containing either one or the other relevant attribute. If the concept had been "red circles," test items of Type I would have contained red circles, those of Type IV would have contained green squares and those of Types II and III would have contained red squares or green circles. Bourne and Haygood (1959; 1961) found that redundant relevant information facilitated concept identification. It can be seen that if the S thinks the concept is "red" or "circles" when it is in fact "red circles," the S will correctly classify items containing both and neither relevant attributes because shape and color are mutually redundant relevant bits of information in these test items (i. e., once either attribute is known, the other is redundant). However, if he thinks this same way for the test items having only one or the other relevant attribute, he will incorrectly classify all of the items of either Item Type II or Item Type III. As a result of this, one would expect the S's mean performance to be higher on Test Item Types I and IV than on Types II and III which, in fact, is the case. Another evidence that Ss do perform this way is the fact there are 13 instances in the data where Ss have gotten all 24 of the items of three of the types correct and all eight of either Item Type II or Item Type III incorrect. On the other hand it never occurred that a S had all of either Item Type I or Item Type IV incorrect while all of the other three types of items were correct. In addition to the 13 instances perfectly exhibiting the expected pattern, there are at least as many more that approximate the expected pattern.

One can argue that the factor of test item type is confounded with the fact that there are more presentation instances of one type than of another on each concept. Specifically, in the presentation of each conjunctive concept there were four cards containing both relevant attributes, one containing one relevant attribute, and one containing the other. No cards containing neither relevant attribute were used in presenting conjunctive concepts. This was necessitated by the fact that the conjunctive concept presentation card series were set up on the basis of a conservative focusing strategy. The first disjunctive concept presentation series contained two instances having both relevant attributes, two having one relevant attribute, one having the other relevant attribute, and two having neither relevant attribute. The second contained two cards having both relevant attributes, one having one relevant attribute, and four having neither relevant attribute. If one argues that test item type performance differences are a function of prior presentation, one has only to look at performance on the conjunctive concepts to see that this is not always true. Table 2 shows that for each conjunctive concept performance was as good or better on Item Type IV, none of which had been shown in the presentation instances, as it was for Item Type I, four of which had been shown in the presentation instances. However, looking at the disjunctive concepts one sees that the second disjunctive concept well fits the hypothesis that performance on the variable of test item type is a function of prior presentations. The means of the first disjunctive concept are not nearly so good an approximation to this hypothesis, but they do not really contradict it.

Table 2

Mean Scores for Each Test Item Type on Each Conjunctive Concept

	I	II	III	IV
First Conjunctive Concept	6.750	6.487	6.025	6.900
Second Conjunctive Concept	7.150	6.563	6.612	7.112

The sequence by concept type interaction indicated that performance on either type of concept was better when that type of concept preceded the other type than when it followed the other type. This is probably an Einstellung or problem-solving set effect (Luchins, 1942). It is interesting to note that a phenomenon that has been replicated many times with other types of problems (Brooks, 1960) also shows up in concept identification tasks. Wells (1963) found that training on disjunctive problems resulted in a shift away from seeking conjunctive solutions and increased the probability that a S would offer disjunctive solutions in tasks where both conjunctive and disjunctive solutions were possible. From the present experiment, it would seem that training on either type of task will increase the probability of a S attempting to solve later concept identification tasks in the same way he has been trained. This result is in agreement with results found in problem-solving set research. It is in disagreement with the result found by Conant and Trabasso (1964) that indicated that there was no significant effect on identification of conjunctive or disjunctive concepts as a result of prior practice on the other type of concept.

Looking at the graph of the interaction of instructions, sequence, and test item type (Fig. 3), and at the graph of the interaction of instructions, concept type, and test item type (Fig. 4), it can be seen that Item Type IV seems to account for much of both interactions. On this item type it will be recalled that the number of presentation instances of this type varied from zero for conjunctive concepts to four for the second disjunctive concept. As a result, it is possible that both of these interactions may be a result of uninstructed Ss' simply attempting to memorize previously presented cards. The amount of prior training on another type of concept, the amount of presentations given a particular item type, and the amount of prior instructions are inextricably related in these interactions. If knowledge concerning them is important, they should be investigated in another experiment.

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